

Institute for Nuclear Problems of the Belarusian State University

# Experience in SfPS program: NATO ARWs on nanoelectromagnetics

Опыт участия в ПНМБ: организация научных семинаров в области наноэлектромагнетизма

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PROBLE





Light Emitting Devices Based on GaAsN-GaN Double Heterostructures NATO SfP Program, # SfP-972614, 1998-2003, Project coordinators: Acad. Z. Alferov (Ioffe PTI, St.-Petersburg, Russia), Prof. A. Hoffman, (Berlin, Germany).

Quantum dot in a microcavity: Local field effects in the strong coupling regime

Collaborative Linkage Grant PST.CLG.980375, 2004-2005, Principal Researchers: A. Hoffmann, (TUB, Germany) S.A. Maksimenko (INP BSU, RB

Good science has been done! New collaborations have been established!



# Nanoelectromagnetics

A research discipline studying behaviour of high-frequency EM radiation on nanometer scale is currently emerging as a synthesis of macroscopic electrodynamics and microscopic theory of electronic properties of different nanostructures





scattering and dissipation

of electromagnetic waves

Propagation,



## Next steps

## **Development of Electromagnetic Wave Absorbing Coatings based on Carbon Onions**

NATO SfP-981051, 2005-2008. Project coordinators:
O. Shenderova (Raleigh, USA),
V.L. Kuznetsov (Novosibirsk, Russia),
Ph. Lambin (Namur, Belgium),
I. Larionova (Dzerzhinsk, Russia),
S. Maksimenko (Minsk, Belarus),
A. Okotrub (Novosibirsk, Russia)

Carbon nanotubes based composite materials for electromagnetic shielding in microwaves,

NATO Collaborative Linkage Grant CBP.EAP.CLG 983910, 2010-2011 Principal Researchers: J. Banis, (Vilnius, Lithuania) and S.A. Maksimenko (Minsk, RB





Good science has been done!Project meeting, Katun river<br/>Chemal, Altay region, RussiaNew collaborations have been established!

Institutional Development of Applied Nanoelectromagnetics: Belarus in ERA Widening FP7-266529 BY-NanoERA

Multifunctional Graphene-based Nanocomposites with Robust EM and Thermal Properties for 3D-printing Application Horizon 2020 734164 Graphene 3D

Nanocarbon based components and materials for high frequency electronics FP7-247007 CACOMEL

Terahertz applications of carbon-based nanostructures FP7-230778 TERACAN

Nanocarbon based composite materials for electromagnetic applications ISTC B-1708

Carbon-nanotube-based terahertz-to-optics rectenna FP7-612285 CANTOR Collective Excitations In Advanced Nanostructures Horizon 2020 - 644076 CoExAN

Nanoelectro magnetics

> international projects

Nano-Thin and Micro-Sized Carbons: Toward EMC Application FP7-610875 NAMICEMC

Terahertz antennas with self-amplified spontaneous emission H2020 – 823728 TERASSE

Radiation tolerant THz sensor H2020 - 777222 ROTOR (ATTRACT+CERN) Graphene/polymer based flexible transparent EM shielding for GHz and THz applications



GRAPHENE FLAGSHIP

FP7- 604391, H2020-649953

Fundamental and Applied Electromagnetics of Nano-Carbons FP7- 318617 FAEMCAR

Nanosized Cherenkov-type THz light emitter based on double-walled carbon, CRDF # AF20-15-61804-1

Dirac Semi-metals based Terahertz Components

H2020 - 823728 DISETCOM

#### ERASMUS+

Uni Namur, Uni Cassino Uni Olomouc



## Institutional Development of Applied Nanoelectromagnetics: Belarus in ERA Widening

EU FP7 BY-NanoERA project FP7-266529, 2010-2013. Call ID FP7-INCO-2010-6 Coordinator S. Maksimenko

## As a principal goal, the project states

Reinforcement of the cooperation capacities of INP BSU in ERA through the institutional development of the new research discipline – applied nanoelectromagnetics

## **Problems to be solved**

- 0 .....
- To establish network with research centers in MS or AC in applied NEM aimed with the progress in solving concrete research problems and submission of joint INCO proposals;
- To develop training modules to build competency and facilitate the participation in FP7 of INP BSU;

 To organize a set of workshops and seminars on NEM;

0 .....

## Project consortium





#### **Fundamental and Applied NanoElectroMagnetics**

 Example 1
 Example 2
 Example 2

The conference provided a forum for scientists specializing in the electromagnetic theory and applied electromagnetics as well as in different areas of the nanoparticles and nanostructured materials physics, chemistry and applications.

The goal is both to stimulate the development of nanoelectromagnetics and to introduce the language and the problems of the present-day electromagnetics and photonics to the nanomaterials research community.





about 120 researchers from 19 countries



# Special Section on Fundamental and Applied Nanoelectromagnetics (20)

S. Maksimenko, INP BSU

### Fundamental & Applied Nano-Electromagnetics NATO Advanced Research Workshop Minsk 2015

### about 50 researchers from 18 countries

Workshop co-Directors Antonio Maffucci University of Cassino and S.L., Cassino, ITALY

**Sergey Maksimenko** Institute for Nuclear Problems Belarusian State University, Minsk, Belarus



Fundamental and Applied Nano-Electromagnetics Prof. A. Lakhtakia PennState USA

Edited by Antonio Maffucci Sergey A. Maksimenko





 
 NATO OTAN
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 Fundamental & Applied Nano-Electromagnetics II THz circuits, materials, devices NATO Advanced Research Workshop Minsk 2018

about 50 researchers from 16 countries <u>Workshop co-Directors</u> **Antonio Maffucci** University of Cassino and S.L., Cassino, ITALY

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HAVER



#### Fundamental and Applied Nano-Electromagnetics II

THz Circuits, Materials, Devices

Edited by Antonio Maffucci Sergey Maksimenko









ANTONIO MAFFUCCI, SERGEY MAKSIMENKO, YUIR SVIRKO

NANOPHOTONICS SERIES

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# **Concluding remarks**

- NATO SfPS program is a constituent part of the INP general strategy of the international collaboration development
- To our knowledge, NATO ARWs organized by INP are the first ARWs in Belarus
- The main role of ARWs organized by INP is the incorporation of the Nanoelectromagnetics into research society and establishing new collaborative links
- Application to NATO SfPS and for NATO ARW is a great piece work preconditioned by
  - ✓ good applied idea within the scope of the NATO SfPS topics
  - ✓ meaningful and well-documented intrinsic experience
  - $\checkmark$  establishing a consortium including industrial partners
  - ✓ availability of a person from NATO country ready for the co-director role
  - ✓ etc.
- Be ready to get negative result. This is competition ....

# THANK YOU FOR ATTENTIO

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